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SEPTEMBER 8, 1986

CHEMICAL & ENGINEERING

# NEWS

Allied-Signal's Mary Good analyzes challenges to the chemical profession
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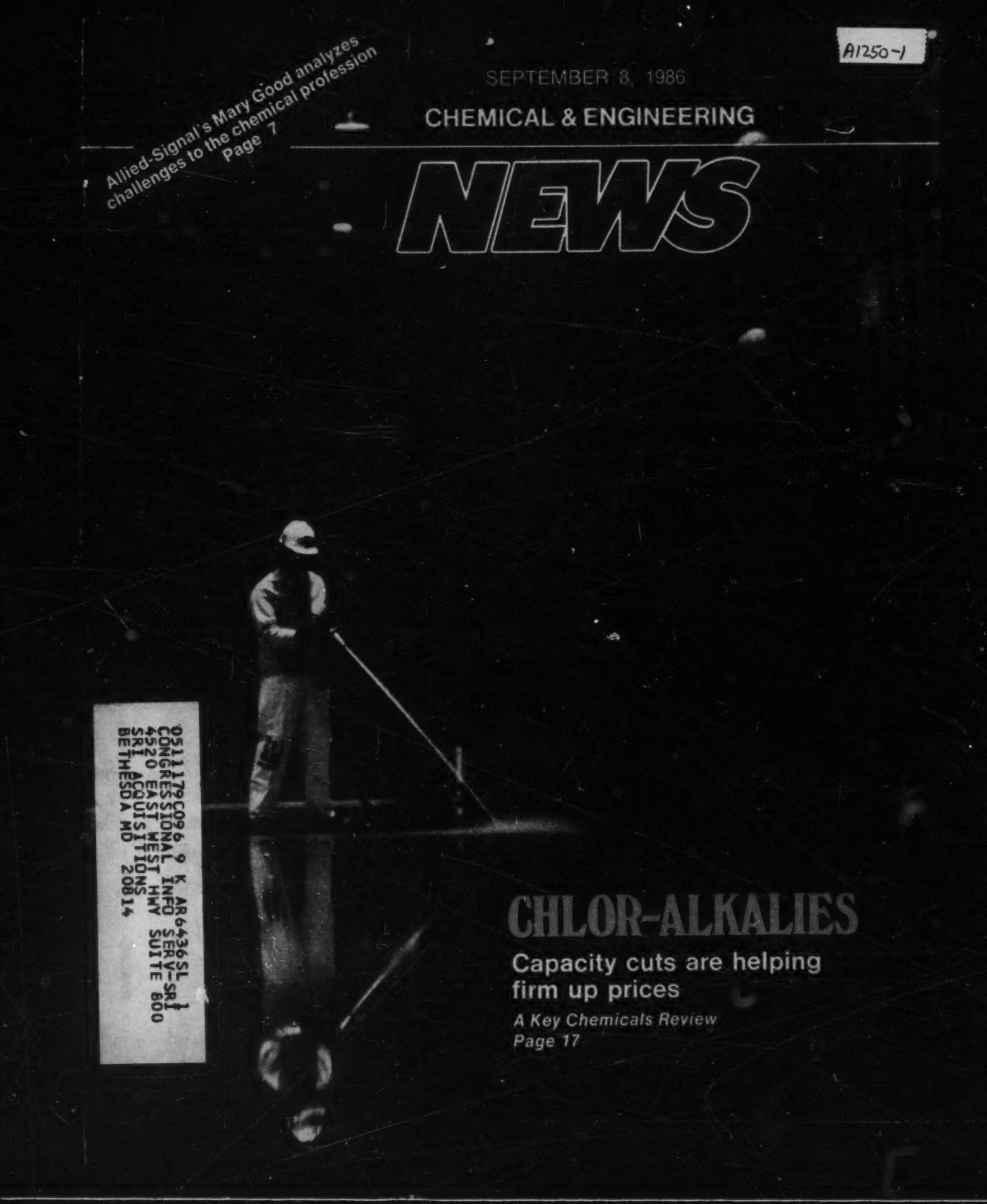

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## CHLOR-ALKALIES

**Capacity cuts are helping firm up prices**

*A Key Chemicals Review*
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## News of the Week

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■ **New vaccine has been developed against simian acquired immune deficiency syndrome; provides hope for AIDS vaccine.** **Page 5**

■ **An Environmental Defense Fund report aims at helping state and federal government agencies reduce the amount of hazardous waste produced.** **Page 5**

■ **Genetic engineering critic Jeremy Rifkin seeks court injunction against DOD biological defense research experiments.** **Page 5**

■ **Use of 2,4-D herbicide linked to increased risk of rare form of cancer, according to study of Kansas farmers who use the pesticide.** **Page 6**

## Business

**Combination of earlier plant shutdowns** to reduce capacity and recent rise in demand has led to firm price increases for makers of chlorine, caustic soda, and soda ash. **Page 17**

## Government

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**Environmental pollution by metals** is a growing concern in the industrialized world; progress has been made in arresting metals pollution, but awareness of the problem must be increased. **Page 37**

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**ACS announces 1987 national award winners;** society comments on Senate version of tax reform legislation, and supports keeping university research facilities eligible for tax-exempt bond financing. **Page 47**

*Cover:* Huge electrolyzers dominate PPG Industries' chlorine-caustic soda plant at Lake Charles, La., where washdown is a regular practice to ensure a clean environment and safe footing

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## News Focus

**Mary Good, Allied-Signal research executive and president-elect of ACS, discusses the threats that afflict the chemical profession and the remedial changes that are needed.** **Page 7**

# PLASTIC RESINS: Output increased 5.5% in first half

Both production and shipments of plastic resins rose in the first half of this year, according to the latest figures released by the Society of the Plastic Industry's Committee on Resin Statistics. Although growth in no way matches the golden years of plastics, the figures do pretty much match average annual growth in the industry for the past five years.

The data, as compiled by the accounting firm of Ernst & Whinney, show output of resins in the first six months totaling almost 21.8 billion lb, up 5.5% from the same period in 1986. Sales and captive use of all resins totaled almost 21.5 billion lb, an increase of 4.9% from the first six months last year. The disparity between the production figures and the shipments numbers indicates that there was some inventory building in the first half.

Demand for thermosets moved up faster than that for thermoplastics, but thermoplastics' output rose faster than thermosets'. According to SPI, thermosetting resin shipments in the first six months totaled 2.95 billion lb, up 5.1% from the 1985 period. Sales and captive use of thermoplastics in the same period increased 4.8% to 18.5 billion lb. Production of thermoplastic resins rose 5.5% to 18.8 billion lb, whereas output of thermosets climbed 5.1% to almost 2.95 billion lb.

The growth leader among the thermosets in both production and shipments was urea resin, with sales and captive use up 7.2% to about 650 million lb and production up 6.8% to 653 million lb. This was closely followed by phenolic and other tar acid resins, whose shipments climbed 6.8% to 1.37 billion lb and whose production increased 6.4% to 1.36 billion lb.

Among the major thermoplastic resins, some showed strong growth. Shipments of polyvinyl chloride increased 10% to 3.63 billion lb; production of the polymer rose 5.0% to 3.56 billion lb. Polystyrene shipments increased 8.1% to 2.21 billion lb and output of this plastic rose 5.5% to 2.14 billion lb. High-density polyethylene sales and captive use climbed 7.3% to 3.35 billion lb; production increased 6.7% to 3.49 billion lb. And demand for polypropylene rose 6.9% to 2.77 billion lb; production of this resin jumped 12.8% to 2.83 billion lb.

The two major thermoplastics performing poorly were low-density polyethylene and acrylonitrile-butadiene-styrene. Sales and captive use of LDPE in the first six months declined 2.6% from the same period a year ago to 4.21 billion lb. Production of LDPE totaled 4.41 billion lb, up just 1.8% from the same period in 1985. Demand for ABS slipped 1.3% to 522 million lb; output of this plastic increased a scant 1.0% to 540 million lb.

The trade surplus in volume remains strong for plastics. Total plastics exports in the first six months amounted to 1.89 billion lb, a gain of 13.1% over the same period last year. Imports totaled 679 million lb, down 1.6% from the first half of the year before. Thus, the poundage surplus was almost 1.22 billion lb, up 23.4% from the first six months of 1985.

Thermoplastics are responsible for the increased trade surplus, with exports up 14.6% in the first six months to 1.80 billion lb and imports down 2.9% to 632 million lb. The volume surplus thus amounted to 1.17 billion lb, an increase of 27.1% from the same period last year.

Thermosets' foreign trade is much smaller than thermoplastics', and their surplus decreased in the first six months. Exports of thermosets amounted to 96 million lb in the first half, down 9.4% from the same period in 1985, and imports were 47 million lb, up 20.5%. As a result, their trade surplus shrank 26.9% to 49 million lb.

Preliminary figures from SPI for July for some individual resins show demand for polystyrene jumping 15.8% to 369 million lb from July 1985. Polypropylene use is up 14.6% to 478 million lb, low-density polyethylene has increased 10.4% to 806 million lb, and polyvinyl chloride rose 5.5% to 575 million lb. Demand has fallen only for high-density polyethylene and acrylonitrile-butadiene-styrene, according to the preliminary estimates, with HDPE slipping 0.3% to 588 million lb and ABS dropping 4.7% to 78.4 million lb. □

**Shipments of most major plastics moved up in first six months**

| millions of lb | First half 1986 | First half 1985 | % change |
|---|---|---|---|
| THERMOSETS | 2,951 | 2,808 | 5.1% |
| Epoxy | 191 | 190 | 0.7 |
| Polyester | 644 | 634 | 1.7 |
| Urea | 650 | 606 | 7.2 |
| Melamine | 97 | 97 | 0.0 |
| Phenolic | 1,369 | 1,282 | 6.8 |
| THERMOPLASTICS | 18,518 | 17,667 | 4.8% |
| Low-density polyethylene | 4,208 | 4,322 | −2.6 |
| High-density polyethylene | 3,354 | 3,127 | 7.3 |
| Polypropylene | 2,775 | 2,594 | 6.9 |
| Acrylonitrile-butadiene-styrene | 522 | 529 | −1.3 |
| Polystyrene | 2,208 | 2,043 | 8.1 |
| Polyvinyl chloride | 3,630 | 3,299 | 10.0 |
| Other | 1,822 | 1,753 | 4.0 |
| TOTAL | 21,470 | 20,475 | 4.9% |

Source: SPI Committee on Resins Statistics as compiled by Ernst & Whinney

# Chlor-Alkalies Profit From Plant Shutdowns

**Capacity rationalization coupled with higher demand shores recent price increases for producers of chlorine, caustic soda, and soda ash**

**Bruce F. Greek,** C&EN Houston

Technological developments aimed at improving efficiency in producing chlorine, caustic soda, and soda ash as well as capacity rationalization and improved demand for these chlor-alkalies are helping to firm prices and to improve profitability for the chlor-alkali industry. If the modest demand growth follows forecasts, sizable expansions of capacity could be needed later on.

Because oversupply had led to lower selling prices and reduced profitability for more than a decade, capacity cutbacks in chlor-alkalies had long been anticipated. In the late 1970s when a return to traditional high operating rates appeared to be certain, capital was authorized for capacity additions, and the stage was set for overcapacity to grow again as the 1980s began. Consequently, the new capacity had to be utilized because of the investment. New process developments, however, occurred about the same time—particularly membrane technology for brine electrolysis cells. Those developments began to make older chlorine cells obsolete.

## Key Chemicals

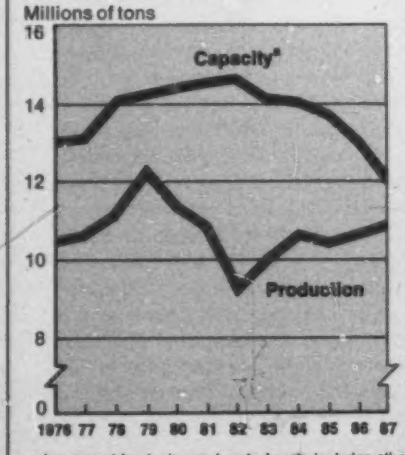
Similar events affected soda ash, although the high cost of pollution control has had the biggest impact. Synthetic soda ash was doomed by costly-to-handle waste streams and by development of natural sources that can be machine-mined at low cost. The end of U.S. manufacture of synthetic soda ash this year has had the same effect that shutdowns of chlorine plants have had: higher operating rates for remaining soda ash plants and higher selling prices.

The outlooks for these three chlor-alkalies differ. U.S. natural soda ash will remain less dependent on energy costs than will chlorine and caustic soda. It will have much lower pollution control costs than will the continuing synthetic production in European and other countries. A continuing rise in U.S. exports of soda ash is forecast as pollution controls become more stringent in other parts of the world. Returns from sales of soda ash do not yet justify the large investment needed to expand capacity at producing points in Wyoming. Because of growth in exports, a tight supply of soda ash before the end of the 1980s is forecast by some observers despite a continuing decline in its major market, glass making.

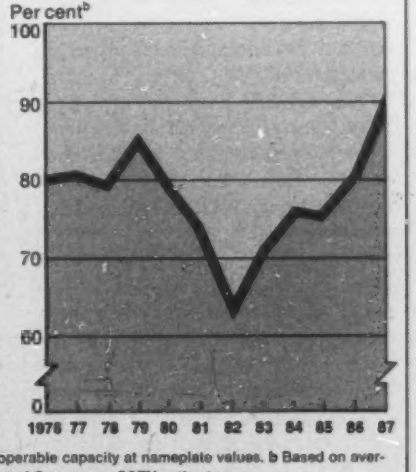
Chlorine and caustic soda consumption could again be buffeted by competition from new capacity built in the Middle East, where energy costs are low. However, as no major additions to capacity by the end of the 1980s in the Middle East have been announced, that situation is unlikely to develop until the next decade. Recently completed capacity in the Middle East has been absorbed into world markets with minor impact on U.S. producers. With U.S. capacity operating above 90% of nameplate and with demand expected to rise modestly throughout the rest of this decade, supplies of the two chlor-alkalies also could tighten.

For some details of the near-term outlook for these chlor-alkalies, please see the following pages.

**Chlorine capacity decline and gains in output . . .**




**. . . raise plant operating rates**



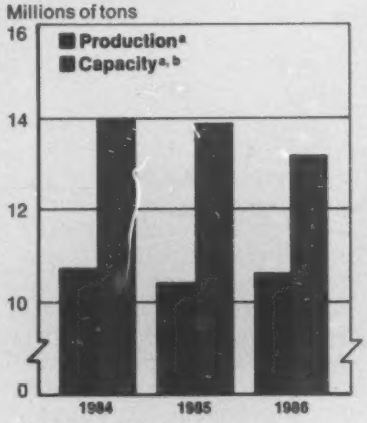

a Average at beginning and end of year; includes all operable capacity at nameplate values. b Based on averaged capacity. **Sources:** Chlorine Institute, Department of Commerce, C&EN estimates

# Chlorine

$Cl_2$

- **Output up slightly**
- **Capacity declining**
- **Prices higher**

## PRODUCTION/CAPACITY




a All sources. b First quarter.

## MAJOR PRODUCERS

*Diamond Shamrock, Dow Chemical, Occidental, Olin, PPG Industries, Vulcan Materials*

## HOW MADE

*Electrolysis of NaCl brine; recovery from HCl; coproduct of metals manufacture, electrolysis of KCl brine*

## MAJOR DERIVATIVES (U.S.)

*Ethylene dichloride 20%, other $C_2$ derivatives 10%*

## MAJOR END USES (U.S.)

*Organic chemicals and plastics 65%, pulp and paper manufacturing 15%*

## FOREIGN TRADE

*Exports—holding at 50,000 tons, imports—rising to 300,000 tons*

## PRICES

*List price $195 per ton on Gulf Coast; actual prices below list*

Chlorine production is forecast to rise about 2% this year. Other good news for producers are recent shutdowns of capacity, which have raised operating rates of remaining on-stream capacity. Also, rising operating rates are allowing the off-list price increases generally to hold.

Total chlorine output in 1986, forecast to reach 10.6 million tons, will be up from last year's production of slightly more than 10.4 million tons, according to the Chlorine Institute. Actual reported production during the early part of 1986 has been below an annualized rate of 10.6 million tons, but sources expect that the traditional up and down swings that occur later in the year will differ from the normal pattern, resulting in the higher total.

Significant capacity changes in 1986 are behind the large increase in operating rates expected this year and in 1987. Two of the recent shutdowns were at major plants. Dow Chemical took 450,000 tons of annual nameplate capacity off the list in July, and Du Pont shuttered about 550,000 tons of capacity at the end of July.

Those large capacity reductions follow shutdowns by several companies in 1985 totaling more than 700,000 annual tons, the Chlorine Institute estimates. Early this year, in-place capacity for chlorine totaled about 13.2 million tons per year. About 900,000 tons of that capacity was closed down, and much of the operating capacity ran at reduced rates.

With another 1 million tons of capacity now down, the total operating capacity is currently 11.3 million tons per year. If production totals 10.6 million tons for the year, and the average operable capacity falls to 12.8 million tons, the operating rate will be almost 83%. Excluding the nonoperating capacity for the entire year, the average rate would be 89%.

Even with the shuttering of a substantial amount of chlorine capacity over the past 18 months, supplies are more than adequate. Growth in demand for chlorine this year is 2%, which matches the rate forecast for the rest of the 1980s. If demand continues to grow at the same rate over the next few years, additional capacity expansions beyond those now under way will be needed. The largest such expansion in progress is a joint venture of Du Pont and Olin at Niagara Falls, N.Y., which would add more than 200,000 tons per year.

There is little change in the use pattern for chlorine. Most major applications are following predictions of no growth to less than 5% annual growth. The largest single use is ethylene dichloride, which eventually becomes various fabricated products of polyvinyl chloride, and this use is having a good year because lower interest rates are spurring housing and auto production. The improvement in the PVC business this year is triggering much of chlorine's production growth. Markets for the other major chlorinated organic chemicals and derivatives are growing slowly, except that for propylene glycol, which is growing well because of demand for polyurethanes.

Bleaching wood pulp is the second largest market for chlorine. Growth in this use also continues to be modest, probably less than 1% annually. Threatening chlorine growth in pulping uses are pollution control concerns, which have brought about efforts to substitute oxygen for chlorine. But progress has been slow, and chlorine will likely keep this market for some time.

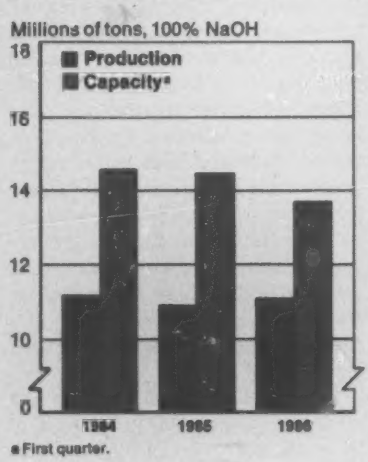
Another major use for chlorine is water treating, which is growing slowly. Concern about forming trihalomethanes as the result of treating water with chlorine has led to proposals for use of other disinfectants such as ozone, hydrogen peroxide, and chloramine, which eventually may cut into this market for chlorine. Other chemical uses of chlorine are relatively small and, although some are having fair growth this year (such as titanium dioxide), the effect on chlorine demand growth is modest.

NaOH

# Caustic soda

- ***Production up slightly***
- ***Capacity dropping***
- ***Prices firming***

## PRODUCTION/CAPACITY




[a] First quarter.

## MAJOR PRODUCERS

*Diamond Shamrock, Dow Chemical, Occidental, Olin, PPG Industries, Vulcan Materials*

## HOW MADE

*Electrolysis of NaCl brine*

## MAJOR DERIVATIVES (U.S.)

*None taking more than 5% of consumption*

## MAJOR END USES (U.S.)

*Chemicals manufacture 50%; pulp and paper manufacturing 20%; soap, detergents, and cleansers manufacture 5%*

## FOREIGN TRADE

*Exports—holding at about 1.1 million tons, imports—rising to about 600,000 tons*

## PRICES

*List price $175 per ton on Gulf Coast; discounting prevalent*

Caustic soda output will increase this year because of a rise in chlorine production and will increase about the same amount, according to the stoichiometry. Except for small quantities added to inventories, the additional output will go into caustic's traditional end uses, dominated by chemical manufacture, which takes about half of U.S. consumption. Because chlorine demand now controls the electrolysis operations, plant capacity for caustic is being reduced roughly the same amount as chlorine capacity. Prices for caustic are weaker than chlorine's because actual demand for caustic is weaker than that for chlorine.

Production of caustic this year will amount to more than 11 million tons as 100% NaOH. (Although most caustic is sold as a 50% solution, production is reported as 100% NaOH.) As a result of plant shutdowns, operable capacity as the year began was about 13.7 million tons, down from 14.5 million tons at the beginning of 1985. Operating capacity at the beginning of 1986 was about 1 million tons less, or about 12.7 million tons. The recent shutdowns of the Dow Chemical and Du Pont chlor-alkali units have reduced capacity about 850,000 tons. For the year, then, the average operable nameplate capacity for making caustic will be reduced to 13.2 million tons. Hence, the operating rates for caustic will be 84% of operable capacity and 91% of operating capacity.

The lower operating rates and a possible 20% gain in imports of caustic (to some 600,000 tons in 1986) keep more pressure on selling prices of caustic than on those of chlorine. Consequently, industry sources point out, caustic is carrying less than its share of the cost of producing an electrochemical unit than is chlorine. This situation will prevail as long as imports rise, exports of caustic remain on hold or decline 5 to 15%, and major uses of caustic languish.

The foreign trade situation for caustic is being buffeted by new production, especially in the Middle East. U.S. exports of caustic, about 1.1 million tons in 1986, could fall 50,000 to 100,000 tons; imports could rise the same amount. Such a change of 100,000 to 200,000 tons in the net of export over imports would have to be either added to U.S. consumption of caustic or put into inventory, if output is to rise about 200,000 tons because of the increase in chlorine output.

The change in the U.S. caustic exports-imports balance stems indirectly from the loss to Middle East producers of some markets formerly held by European producers. As a result, European producers now either are exporting to the U.S. or are competing with U.S. exports going to such areas as Australia and the Caribbean. At present, the capacity of the new Middle East plants has been adsorbed.

U.S. consumption of caustic could be stimulated to some degree by relatively lower prices. Some soda ash used in making certain inorganic chemicals might temporarily be displaced by caustic because of the higher prices for soda ash. However, caustic's dominant use to make chemicals means that demand for chemicals controls its consumption. One of the largest uses for caustic is in converting bauxite ore to alumina (which accounts for the use of a large share of exports). Because aluminum output is down and process improvements reduce caustic consumption, this market has sagged. The many other uses for inorganic chemicals are making up in large part for the decline in this market. Production of organic chemicals, particularly aromatic derivatives, requires large quantities of caustic for neutralization of the waste stream. Growth in this area is modest, at about 2% annually.

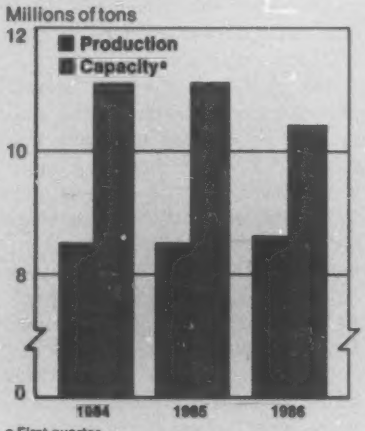
Nonchemical manufacturing uses—pulp and paper, soap and detergents and cleansers, and petroleum processing—are growing slightly, if at all, this year. Many of these applications are mature and are not expected to grow much in the future.

$Na_2CO_3$

# Soda ash

- *Output slowly rising*
- *Capacity down*
- *Prices holding*

## PRODUCTION/CAPACITY




* First quarter.

## MAJOR PRODUCERS

*Chesebrough-Pond's, FMC, Henley Group (Allied), Kerr-McGee, Tenneco, Texasgulf*

## HOW MADE

*Recovered from mined trona ore or from brine*

## MAJOR DERIVATIVES (U.S.)

*None accounting for more than 5% of consumption*

## MAJOR END USES (U.S.)

*Glass manufacture 50%; chemicals manufacture 25%; soap, detergents, and cleansers manufacture 10%*

## FOREIGN TRADE

*Exports—rising to 2 million tons, imports—rising to 75,000 tons*

## PRICES

*List price in hopper-car quantities in Wyoming $83 per ton*

Exports of soda ash continue to rise and brighten the outlook for an otherwise slow soda ash market this year. Exports of this chemical are expected to top 2 million tons in 1986, which would be close to a quarter of total U.S. output. Domestic uses—headed by glass manufacture—may be up slightly but could be almost level.

Although Allied (now Henley Group) stopped making synthetic soda ash during the first quarter of the year, total production of soda ash in 1986 is forecast to increase over last year's output. The total this year could be 8.7 million tons, especially if export volume grows throughout the year as forecast. However, production probably will be only slightly over 8.6 million tons. Such an increase would be less than 1.5% over 1985 output of more than 8.5 million tons, and that is up only marginally over 1984 production of less than 8.5 million tons.

All soda ash currently is produced either from naturally occurring trona ore mined in the area around Green River, Wyo., or from naturally occurring brines in California. The expected shutdown of the Allied plant in Syracuse, N.Y., which has a capacity of 700,000 tons per year, reduced U.S. nameplate capacity for soda ash to about 10.4 million tons annually.

Effective capacity for soda ash is about 90% of nameplate, or nearly 9.4 million tons per year. If production in 1986 totals 8.7 million tons, the operating capacity will have an average rate of 93% of effective capacity, or 84% of nameplate capacity. Because of the shutdown of the synthetic capacity, these operating rates will be the highest the soda ash industry has had for many years.

Reductions in capacity and strong exports have allowed soda ash producers to raise their list prices $4.00 per ton for carload quantities at the producing plant sites and to maintain the higher price for nearly a year. With prospects for further gains in exports next year and for possibly a small growth in U.S. consumption as well, the higher prices are expected to hold through the rest of this year and later. Actual selling prices, however, have been below list prices for some time.

The growth in U.S. exports of soda ash continues to be in the areas of existing exports, in particular the Pacific Rim nations. Global consumption of soda ash, however, is growing rather rapidly because of growing demand in developing countries for glass containers. Synthetic soda ash capacity worldwide also is expected to continue growing. Nevertheless, total capacity growth lags demand growth, spurring demand for U.S. natural soda ash in many parts of the world. No plans have been announced at this time for possible expansion of U.S. capacity.

Major uses of soda ash are not progressing much this year. Glass of all kinds accounts for half of U.S. consumption of soda ash and its output is slowly declining, taking soda ash consumption with it. The four segments of the glass market have somewhat different outlooks. Glass containers, about two thirds of the total glass market for soda ash, are buffeted by continuing inroads by both plastics (largely polyesters) and aluminum. Their consumption fell last year and is expected to decline further in 1986. Use of flat glass, largely in construction and autos, will be up slightly because of improved sales of houses and autos resulting from lower interest rates. Flat glass accounts for about one sixth of soda ash use in glass. The remaining glass forms—glass fiber and glassware—are forecast to hold about even in demand for soda ash.

All of the other major applications—manufacture of chemicals, pulp and paper, and soaps, detergents, and cleansers—will be flat to slightly up in their consumption of soda ash in 1986. These uses and many small ones will not change total consumption of soda ash from that of last year.